light beams from the marking or reflectance boundary portion on the linear encoder scale and to detect a scale origin from a difference signal between the plurality of light receiving signals.--

REMARKS

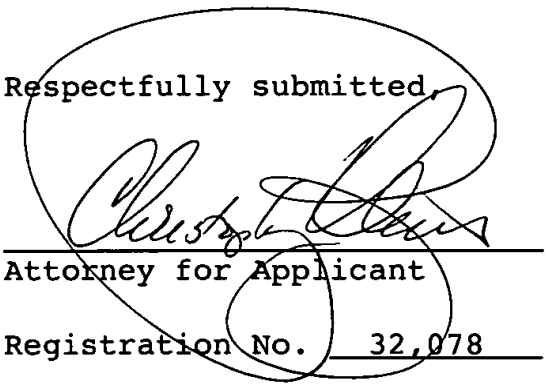
The present application is being filed concurrently herewith.

The claims pending in the present application are Claims 1 to 20, the independent claims being Claims 1, 7, 10 to 15 and 18 to 20. Claims 8 to 15 have been amended herein and Claims 16 to 20 have been added to improve the form of the claims under U.S. patent practice. No new matter has been added.

Applicant submits that the present application is in allowable form. Favorable consideration of the application and early passage to issue respectfully are requested.

Applicant's undersigned attorney may be reached in our Washington, D.C. office by telephone at (202) 530-1010. All correspondence should continue to be directed to our below listed address.

Respectfully submitted,



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VERSION WITH MARKS TO SHOW CHANGES MADE TO CLAIMS

8. (Amended) An apparatus according to claim 1 [or 7], wherein said light beam splitting optical system is a crystal optical element.

9. (Amended) An apparatus according to claim 1 [or 7], wherein a boundary portion is formed on the surface of the relatively moving object to generate a reflectance difference.

10. (Amended) A magnetic recording apparatus [using said] comprising:

a displacement detection apparatus [of claim 4,] comprising:

a light beam illuminating system for converting a linearly polarized light beam emitted from a light emitting element into a substantially parallel light beam and irradiating a relatively moving object with the light beam through a light beam splitting optical system, said light beam splitting optical system splitting the single parallel light beam emerging from

said light beam illuminating system into a plurality of polarized light beams whose polarized states are different from each other;

a focusing optical system for focusing the plurality of split light beams to different positions on a surface of the relatively moving object;

a polarizing prism for splitting reflected light beams from the relatively moving object on the basis of a difference between the plurality of directions of polarization;

a plurality of light receiving optical systems for individually detecting the different polarized light beams split by said polarizing prism and outputting light receiving signals of the respective light beams; and

a comparator for comparing light receiving signal levels of the respective light beams to detect a relative displacement of the relatively moving object,

wherein a slit-shaped marking or a three-dimensional marking is formed on the surface of

the relatively moving object to generate a reflectance difference;

a head arm having the marking or reflectance boundary portion formed on an upper surface;

a rotary positioner having said displacement detection apparatus on a rotary arm; and

a head arm drive motor control unit for controlling a current of a head arm drive motor of a hard disk drive to synchronize a motion of said rotary positioner with a motion of said head arm so that an output from said displacement detection apparatus becomes constant as a position of said rotary positioner varies.

11. (Amended) A rotary encoder [using said] comprising:

a displacement detection apparatus [of claim 4,] comprising:

a light beam illuminating system for converting a linearly polarized light beam emitted from a light emitting element into a substantially parallel

light beam and irradiating a relatively moving object with the light beam through a light beam splitting optical system, said light beam splitting optical system splitting the single parallel light beam emerging from said light beam illuminating system into a plurality of polarized light beams whose polarized states are different from each other;

a focusing optical system for focusing the plurality of split light beams to different positions on a surface of the relatively moving object;

a polarizing prism for splitting reflected light beams from the relatively moving object on the basis of a difference between the plurality of directions of polarization;

a plurality of light receiving optical systems for individually detecting the different polarized light beams split by said polarizing prism and outputting light receiving signals of the respective light beams; and

a comparator for comparing light receiving signal levels of the respective light beams to detect a relative displacement of the relatively moving object,

wherein a slit-shaped marking or a three-dimensional marking is formed on the surface of the relatively moving object to generate a reflectance difference;

wherein the slit-shaped marking or reflectance boundary portion is formed on a rotary disk surface; and

said displacement detection apparatus is provided on a fixed object side to receive the plurality of reflected light beams from the marking or reflectance boundary portion on a moving scale and to detect a scale origin from a difference signal between the plurality of light receiving signals.

12. (Amended) A linear encoder [using said] comprising:

a displacement detection apparatus of [claim 4,] comprising:

a light beam illuminating system for converting a linearly polarized light beam emitted from a light emitting element into a substantially parallel light beam and irradiating a relatively moving object with the light beam through a light beam splitting optical system, said light beam splitting optical system splitting the single parallel light beam emerging from said light beam illuminating system into a plurality of polarized light beams whose polarized states are different from each other;

a focusing optical system for focusing the plurality of split light beams to different positions on a surface of the relatively moving object;

a polarizing prism for splitting reflected light beams from the relatively moving object on the basis of a difference between the plurality of directions of polarization;

a plurality of light receiving optical systems for individually detecting the different polarized light beams split by said polarizing prism and outputting

light receiving signals of the respective light beams; and

a comparator for comparing light receiving signal levels of the respective light beams to detect a relative displacement of the relatively moving object,

wherein a slit-shaped marking or a three-dimensional marking is formed on the surface of the relatively moving object to generate a reflectance difference;

wherein the slit-shaped marking or reflectance boundary portion is formed on a linear encoder scale surface[;], and

said displacement detection apparatus is provided on a moving object side to receive the plurality of reflected light beams from the marking or reflectance boundary portion on the linear encoder scale and to detect a scale origin from a difference signal between the plurality of light receiving signals.

13. (Amended) A magnetic recording apparatus [using said] comprising:

a displacement detection apparatus [of claim 9,] comprising:

a light beam illuminating system for converting a linearly polarized light beam emitted from a light emitting element into a substantially parallel light beam and irradiating a relatively moving object with the light beam through a light beam splitting optical system, said light beam splitting optical system splitting the single parallel light beam emerging from said light beam illuminating system into a plurality of polarized light beams whose polarized states are different from each other;

a focusing optical system for focusing the plurality of split light beams to different positions on a surface of the relatively moving object;

a polarizing prism for splitting reflected light beams from the relatively moving object on the

basis of a difference between the plurality of directions of polarization;

a plurality of light receiving optical systems for individually detecting the different polarized light beams split by said polarizing prism and outputting light receiving signals of the respective light beams; and

a comparator for comparing light receiving signal levels of the respective light beams to detect a relative displacement of the relatively moving object,

wherein a boundary portion is formed on the surface of the relatively moving object to generate a reflectance difference;

a head arm having the marking or reflectance boundary portion formed on an upper surface;

a rotary positioner having said displacement detection apparatus on a rotary arm; and

a head arm drive motor control unit for controlling a current of a head arm drive motor of a hard disk drive to synchronize a motion of said rotary positioner with a motion

of said head arm so that an output from said displacement detection apparatus becomes constant as a position of said rotary positioner varies.

14. (Amended) A rotary encoder [using said] comprising:

a displacement detection apparatus [of claim 9,] comprising:

a light beam illuminating system for converting a linearly polarized light beam emitted from a light emitting element into a substantially parallel light beam and irradiating a relatively moving object with the light beam through a light beam splitting optical system, said light beam splitting optical system splitting the single parallel light beam emerging from said light beam illuminating system into a plurality of polarized light beams whose polarized states are different from each other;

a focusing optical system for focusing the plurality of split light beams to different positions on a surface of the relatively moving object;

a polarizing prism for splitting reflected light beams from the relatively moving object on the basis of a difference between the plurality of directions of polarization;

a plurality of light receiving optical systems for individually detecting the different polarized light beams split by said polarizing prism and outputting light receiving signals of the respective light beams; and

a comparator for comparing light receiving signal levels of the respective light beams to detect a relative displacement of the relatively moving object,

wherein a boundary portion is formed on the surface of the relatively moving object to generate a reflectance difference;

wherein the slit-shaped marking or reflectance boundary portion is formed on a rotary disk surface,[;] and

said displacement detection apparatus is provided on a fixed object side to receive the plurality of reflected light beams from the marking or reflectance boundary portion on a moving scale and to detect a scale origin from a difference signal between the plurality of light receiving signals.

15. (Amended) A linear encoder [using said] comprising:

a displacement detection apparatus [of claim 9,] comprising:

a light beam illuminating system for converting a linearly polarized light beam emitted from a light emitting element into a substantially parallel light beam and irradiating a relatively moving object with the light beam through a light beam splitting optical system, said light beam splitting optical system splitting the single parallel light beam emerging from said light beam illuminating system into a plurality of

polarized light beams whose polarized states are different from each other;

a focusing optical system for focusing the plurality of split light beams to different positions on a surface of the relatively moving object;

a polarizing prism for splitting reflected light beams from the relatively moving object on the basis of a difference between the plurality of directions of polarization;

a plurality of light receiving optical systems for individually detecting the different polarized light beams split by said polarizing prism and outputting light receiving signals of the respective light beams; and

a comparator for comparing light receiving signal levels of the respective light beams to detect a relative displacement of the relatively moving object,

wherein a boundary portion is formed on the surface of the relatively moving object to generate a reflectance difference;

wherein the slit-shaped marking or reflectance boundary portion is formed on a linear encoder scale surface[;] and

said displacement detection apparatus is provided on a moving object side to receive the plurality of reflected light beams from the marking or reflectance boundary portion on the linear encoder scale and to detect a scale origin from a difference signal between the plurality of light receiving signals.